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ENGINEERING CHANGE NOTICE

1. ECN 666067

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental ☐ Direct Revision ☒ Change ECN ☐ Temporary ☐ Standby ☐ Supersedure ☐ Cancel/Void ☐	B. R. Johns, ISE, S7-24, 373-3429	☒ Yes ☐ No	04/09/01
	6. Project Title/No./Work Order No. Interim Stabilization, Essential Drawings, 113340	7. Bldg./Sys./Fac. No. 241-G/200-GEN	8. Approval Designator N/A
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) RPP-7567, REV. 0	10. Related ECN No(s). N/A	11. Related PO No. N/A

12a. Modification Work	12b. Work Package No.	12c. Modification Work Completed	12d. Restored to Original Condition (Temp. or Standby ECNs only)
☐ Yes (fill out Blk. 12b) ☒ No (NA Blks. 12b, 12c, 12d)	N/A	N/A Design Authority/Cog. Engineer Signature & Date	N/A Design Authority/Cog. Engineer Signature & Date

13a. Description of Change — 13b. Design Baseline Document? ☒ Yes ☐ No

This ECN is a direct revision of document RPP-7567, revision 0. Changes were made to ladder 7 of the PLC program. Pump interlock and pump trouble logic were added to rungs 2, 3 and 6. This was done to compensate for the two-hundredth-of-a-second timer in rung 3 to prevent momentary starter energizing upon a start attempt when the pump interlock is not made up.

A categorical exclusion USQ screening is used since this document incorporates changes made by a modification ECN that has been USQ screened.

14a. Justification (mark one)	14b. Justification Details
Criteria Change ☒ Design Improvement ☐ Environmental ☐ Facility Deactivation ☐ As-Found ☐ Facilitate Const. ☐ Const. Error/Omission ☐ Design Error/Omission ☐	This direct revision of RPP-7567 updates the document to the current PLC software configuration. Design verification by Informal review per HNF-IP-0842, volume IV, section 4.24. USQ tracking #TF-98-1201, revision 1. This direct revision will not change collective dose since it has no impact on radiological sources, contamination control or shielding.

15. Distribution (include name, MSIN, and no. of copies)

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ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1): 666067

16. Design Verification Required

☒ Yes
☐ No

17. Cost Impact

	ENGINEERING		CONSTRUCTION	
Additional	☐	$ N/A	☐	$ N/A
Savings	☐	$ N/A	☐	$ N/A

18. Schedule Impact (days)

Improvement ☐ N/A
Delay ☐ N/A

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by *the change described in Block 13. Enter the affected document number in Block 20.*

SDD/DD	☐	Seismic/Stress Analysis	☐	Tank Calibration Manual	☐
Functional Design Criteria	☐	Stress/Design Report	☐	Health Physics Procedure	☐
Operating Specification	☐	Interface Control Drawing	☐	Spares Multiple Unit Listing	☐
Criticality Specification	☐	Calibration Procedure	☐	Test Procedures/Specification	☐
Conceptual Design Report	☐	Installation Procedure	☐	Component Index	☐
Equipment Spec.	☐	Maintenance Procedure	☐	ASME Coded Item	☐
Const. Spec.	☐	Engineering Procedure	☐	Human Factor Consideration	☐
Procurement Spec.	☐	Operating Instruction	☐	Computer Software	☐
Vendor Information	☐	Operating Procedure	☐	Electric Circuit Schedule	☐
OM Manual	☐	Operational Safety Requirement	☐	ICRS Procedure	☐
FSAR/SAR	☐	IEFD Drawing	☐	Process Control Manual/Plan	☐
Safety Equipment List	☐	Cell Arrangement Drawing	☐	Process Flow Chart	☐
Radiation Work Permit	☐	Essential Material Specification	☐	Purchase Requisition	☐
Environmental Impact Statement	☐	Fac. Proc. Samp. Schedule	☐	Tickler File	☐
Environmental Report	☐	Inspection Plan	☐	NONE	☒
Environmental Permit	☐	Inventory Adjustment Request	☐		☐

20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number/Revision
N/A	N/A	N/A

21. Approvals

	Signature	Date
Design Authority	WF ZUROFF *[signature]*	4/17/01
Cog. Eng.	BR JOHNS *BR Johns*	4/9/01
Cog. Mgr.	TM HORNER *T.W. Horner*	4/16/01
QA	N/A	
Safety	N/A	
Environ.	N/A	
Other	Informal Review: *[signature]* T.NGUYEN	4/17/01

	Signature	Date
Design Agent		
PE		
QA		
Safety		
Design		
Environ.		
Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

DISTRIBUTION SHEET

To	From	Page 1 of 1
Release Station	B. R. Johns	Date 04/09/01
Project Title/Work Order		EDT No.
RPP-7567, REPORT ON NEW PUMPING SYSTEM SOFTWARE ON PUMPING INSTRUMENTATION AND CONTROL SKIDS		ECN No. 666067

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
B. R. Johns	S7-24	1			
M. R. Koch	S7-24	1			
T. H. Nguyen	S7-24	1			
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REPORT ON NEW PUMPING SYSTEM SOFTWARE ON PUMPING INSTRUMENTATION AND CONTROL SKIDS

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U.S. Department of Energy Contract DE-AC27-99RL14047

EDT/ECN:	666067	UC:	
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Key Words: PICS, SALTWELLS, SKIDS, INTERIM STABILIZATION, SOFTWARE

Abstract:
This supporting document documents the software changes to the PLC and DTAM to operate the new pumping system from the PIC skids.

Barbara Wolski 4/19/01
Release Approval Date

APR 19 2001
DATE:
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Release Stamp

Approved For Public Release

RECORD OF REVISION

(1) Document Number: RPP-7567

Page 1

(2) Title
REPORT ON NEW PUMPING SYSTEM SOFTWARE ON INSTRUMENTATION AND CONTROL SKIDS

Change Control Record

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release	
		(5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) EDT 631427, (ORIGINAL)	B.R. JOHNS	M.R.KOCH 1/23/00
RS 1	ECN 666067, Direct revision. Minor corrections and revision due to changes to software program.	BRJohns	T.M. Horner 4/16/01

TABLE OF CONTENTS

REPORT ON NEW PUMPING SYSTEM SOFTWARE ON PUMPING INSTRUMENTATION AND CONTROL SKIDS

1.0 INTRODUCTION

1.1 This report documents the details of the Programmable Logic Controller (PLC) and the Data Table Access Module (DTAM) logic developed for the new pumping system employed for saltwell pumping. The new system is planned first for pumping A-101 where Pumping Instrumentation and Control (PIC) skid "P" is located. The new pump requires a bump start under certain conditions that will be controlled by the PLC. The bump start is to ensure sufficient water to the pump bearing cavities.

1.2 The PLC logic is required to control the shutdown of the injection pump that supplies the water to the saltwell pump bearing cavities. Allowance to start and stop the injection pump will be controlled by the PLC at the PIC skid.

1.3 This report is written for PIC skid "P", but will apply to other PIC skids where the new pumping system is deployed. The logic will remain the same, but the ladder rung-numbers may change from skid to skid.

2.0 REQUIREMENTS AND ASSUMPTIONS

2.1 The following requirements were used to develop the software changes for the PLC and DTAM. Requirements are for both the new pump operation and the injection water pump.

2.1.1 Injection pump must run at least 10 minutes prior to the saltwell pump being started. This is recommended by the vendor to ensure adequate water flow to the bearings.

2.1.2 A flow switch on the injection water line provides an interlock for the saltwell pump control. The flow switch interlock shuts down the pump should low flow or loss of cooling water to the bearings occurs.

2.1.3 The saltwell pump is to be "bump" started the first time the injection pump is started or restarted by monitoring the flow switch. The "bump" start is recommended by the vendor to ensure air is removed from the bearing cavity to allow water in the cavity for bearing cooling.

2.1.4 The "bump" sequence is to consist three sequences of 1 second run and 10 seconds of OFF time for the saltwell pump. These times and sequence are recommendations by the pump vendor.

2.1.5 Stop the injection pump 30 minutes after the saltwell pump shuts down. The shutdown helps minimize the amount of water being pumped into the transfer line and tank.

2.1.6 Stop the injection pump 40 minutes after starting if the saltwell pump is not started. (Allow 10 minutes for the initial water flow to the saltwell pump and then 30 minutes for starting the saltwell pump.) This is a safety precaution requested by operations to prevent unnecessary amounts of water from being pumped into the transfer line and tank.

2.1.7 Stop the injection pump 5 seconds after a high transfer pressure trip of the saltwell pump. This shutdown of the injection pump will prevent pressure buildup in the transfer line should the line become plugged.

2.1.8 A power monitor interlock is to be in the control logic to shut down the saltwell pump. The power monitor is to help protect the motor and provides information on the operation of the pump.

2.1.9 A motor winding high temperature interlock is to be in the control logic to shut down the saltwell pump. This temperature monitoring and interlock helps protect the motor from permanent damage.

2.1.10 An alarm to motor winding high temperature shutdown is requested to warn operators of approach to shut down of the saltwell pump.

2.1.11 A bearing wear alarm is requested to warn of the pump bearing condition.

2.1.12 A flush water temperature indication is to be provided at the skid on the DTAM screen.

2.1.13 Estimate the amount of water from the injection pump into the system using the flow switch and flow rate value. It is assumed a display to the nearest gallon is sufficient. Display the estimated value on the DTAM screen.

2.1.14 Apply appropriate bypasses during the bump start to prevent unnecessary alarms and/or shutdown outputs to other skids from occurring. This will include the horn, strobe light, pump trouble, and shutdown output to other skids.

2.1.15 Provide a DTAM screen to enter the injection flow rate as a decimal value.

2.1.16 Revise the dilution subroutine to account for injection water into the pumping system.

3.0 PLC ADDRESS CHANGES

3.1 PLC input from the recirculation pressure transducer is removed. The recirculation transducer is no longer required due to the new pump configuration where the pump bearings are cooled by an outside water source rather than the recirculation of waste through the pump bearings. This transducer is removed and replaced with a back-flow preventer with no inputs to the PLC.

3.2 The thermocouple input to the PLC form the motor bearing is removed since the new motor has no bearing thermocouple elements.

3.3 A new PLC input (address N60:16) is added for the motor winding temperature RTD. This is a 4 to 20mA input that comes from the RTD module in the Intrinsic Safe panel on the PIC skid. The RTD input from the motor windings is run to the Intrinsic Safe panel module that converts the resistance to a 4 to 20mA signal.

3.4 A new PLC output (address N60:20/1) is added for injection pump start/stop control from the PIC skid.

3.5 A new PLC input (address N60:20/6) is added to monitor the injection pump run status.

3.6 Additional heat trace control is provided for the pump piping assembly heat trace. This makes use of addresses N60:29/0, N60:29/2, N60:29/4, and N60:29/5.

3.7 Bearing monitor input uses address N60:30/7.

3.8 The injection flow switch input uses address N60:30/10.

3.9 The power monitor uses address N60:31/8.

3.10 Two new thermocouples, one for the pump piping assembly and one for the flush water temperatures use addresses N60:34 and N60:35 respectively.

4.0 DTAM ALARM CHANGES

4.1 Alarm 14 is changed to "MOTOR WINDING HIGH TEMP SHUTDOWN."

4.2 Alarm 39 is changed to "PUMP INJECTION WATER LOW FLOW."

4.3 Alarm 40 is changed to "POWER MONITOR HI/LO SHUTDOWN."

4.4 Alarm 58 is changed to "PUMP WORN BEARING ALERT."

4.5 Alarm 59 is changed to "MOTOR WINDING HI TEMP WARNING."

5.0 PLC OUTPUTS TO OTHER SKIDS

5.1 The recirculation high-pressure and signal loss outputs to other skids is removed. These outputs no longer exist since the recirculation transducer is removed.

6.0 PLC LADDER LOGIC CHANGES

6.1 This section describes in detail the PLC ladder logic changes for the new pumping system. The changes are made to incorporate the requirements in section 2.0 above.

6.2 Ladder 2: A new subroutine 21 is added for the calculation of the injection water volume.

6.3 Ladder 3: This is the first pass subroutine used to set initial conditions in the remaining ladder logic. Three new rungs 6 through 8 are added to set initial conditions for the bump start logic in ladder 7. These settings are to ensure that a bump start will be set for the first time the PLC is turned ON. One new rung 9 is added to ensure the volume in subroutine 21 does not reset unexpectedly.

6.4 Ladder 4: Rung 1 is changed to remove data module 6. New rung 2 is added for data module 6 since it is changed from an analog to a relay data module.

6.5 Ladder 5: This ladder is the alarm activation and interlocks for the saltwell pump motor. The following changes were made.

  6.5.1 The trip point in rung 0 is changed from 15 psig to 30 psig. This is due to the additional pressure from the injection water pump attached to the system.

  6.5.2 Rung 6 has a bump relay contact added that is **TRUE** when the bump sequence is not active or during the bump sequence when the pump is running for the 1 second time period. The contact is **FALSE** during the 10-second shut-off time during the bump sequence to prevent a pump trouble alarm and interlock break from occurring.

  6.5.3 Rung 17 has the pump low temperature logic portion is changed from the pump bearing thermocouple to the pump assembly thermocouple since the pump bearing temperature no longer exists. Alarm 8 will now activate upon jumper heat trace high temperature or low pump piping temperature.

  6.5.4 Rung 22 has a bump permissive contact inserted that is **TRUE** when the bump sequence is inactive. The contact is **FALSE** when the bump sequence is active to prevent the shutdown alarm and horn during the 10 second off time during the bump sequence. A time delay contact is used to prevent a false alarm during the switch from bump to normal start.

6.5.5 Rungs 24 and 25 are deleted since the recirculation pressure transducer no longer exists. Two new rungs 24 and 25 are inserted for the motor winding temperature high shutdown and warning. Rung 24 monitors the winding temperature and will break the interlock and activate alarm 14 when the temperature is 390 degrees F or higher. The interlock will remake and alarm clear upon the temperature dropping below 370 degrees F. The logic functions as follows: when the temperature is 390 degrees F or higher, the two GEQ become **TRUE** thus making the interlock and alarm outputs **TRUE**. The reset contact N20:52/10 becomes **TRUE**. When the temperature drops below 390 degrees, the first GEQ becomes **FALSE**, but the rung remains **TRUE** due to the reset contact. When the temperature drops below 370 degrees, then the second GEQ becomes **FALSE**, thus making the alarm, interlock and reset elements in the rung **FALSE**. New rung 25 functions in the same manner except the true setting is at 380 degrees F, but the reset point is the same at 370 degrees. There is no interlock associated with rung 25, only alarm 59. This rung is to provide a warning to the operator that the motor temperature is approaching the high shutdown temperature.

6.5.6 Rungs 56 through 57 are deleted. The recirculation pressure and signal loss are no longer used. The motor bearing temperature is replaced with the motor winding high temperature in new rungs 24 and 25 described above. A new rung 56 is added for the power monitor interlock and alarm. The series high and low power contacts on the power monitor are monitored by address N60:31/8. When either of the power monitor contacts open, the N60:31/8 contact in rung 56 becomes **TRUE**. If the pump motor is running, then when the power monitor contact is true, the interlock and alarm outputs become **TRUE** thus breaking the motor interlock and activating alarm 40. The power monitor has internal circuitry for delays for startup power changes. The interlock and alarm clear upon pump shutdown due to both the motor and power monitor contacts resetting making the rung **FALSE**.

6.5.7 Rung 62, now renumbered 61, has a dilution contactor input inserted. This will allow the dilution no flow alarm and interlock to be active only when the dilution pump is ON. The dilution pump may not run all the time with the injection pump inputting water into the system. When the saltwell and dilution pumps are running, the N60:31/6 and N60:28/1 contacts are **TRUE**. Should a low flow occur, then contact N60:28/7 becomes **TRUE** and starts the 5-minute timer. Upon timing out, rung 62 becomes **TRUE** to shutdown the saltwell and dilution pumps and activates alarm 35. Should the dilution pump be off when the saltwell pump is running, the contact N60:28/1 is **FALSE** to keep rung 61 false.

6.5.8 Rungs 66 and 67 are deleted for the recirculation high-pressure interlock and alarm since the recirculation transducer no longer exists.

6.5.9 New rungs 65 through 68 are added. Rung 65 is an alarm only for the worn bearing alert. Contact N60:30/7 becomes **TRUE** when the bearing monitor field contact opens, thus activating alarm 58. Rungs 66 to 68 are for the injection water low flow interlock and alarm. Address N60:30/10 monitors the flow switch field contact. The field contact is closed on normal flow and opens on low flow. On low flow, contact N60:30/10 in rung 66 is **TRUE** and makes timer T4:62 **TRUE**. After 2 seconds, the timer done contact in rung 67 becomes **FALSE** and resets timer T4:89. Resetting of timer T4:89 causes the timer done contact in rung 68 to become **TRUE**, thus causing the interlock and alarm 39 outputs to become **TRUE**. On normal flow, the contact in rung 66 becomes **FALSE** and resets the 2-second timer. Upon resetting, the timer done contact in rung 67 becomes **TRUE** and starts the 10-minute timer T4:89. After 10 minutes, the timer done contact in rung 68 becomes **FALSE**, and the interlock and alarm 39 to clear. The two-second timer is used to prevent water transients from causing false interlock breaks and alarm. The 10-minute timer is used to meet the requirement to have 10 minutes of injection water flow to the pump-bearing cavity after the flow switch.

6.5.10 Rung 73, now rung 74, has a bump permissive contact inserted to prevent shutdown output to the other skids during the bump permissive sequence. The bump permissive contact in this rung is **FALSE** during the bump shutdown portion of the sequence to keep the rung **FALSE**. The contact is **TRUE** when the bump permissive is **FALSE** or when the bump sequence is inactive to allow an output during normal operation of the pump. A delay contact is used to prevent erroneous shutdown output during the switching from bump to normal start.

6.5.11 Rungs 77 and 78 are deleted. These are outputs to the other skids for recirculation high pressure and loss of signal. These interlocks no longer exist.

6.5.12 Rungs 84 and 85, which are now rungs 83 and 84 due to the deletion of other rungs, have three interlock changes. The interlock contacts for high recirculation pressure, loss of recirculation signal and motor bearing high temperature are replaced with motor winding high temperature, power monitor high/low power, and injection water flow switch. These contacts are **TRUE** for normal conditions.

6.6 Ladder 7 has rung 0 replaced with new rungs 0 through 16. These new rungs are used to determine whether a bump or normal start will occur; provide for the normal or bump start sequence; and provide for injection pump shutdown after the saltwell pump shuts down. The following explains the ladder logic.

6.6.1 Rungs 0 and 1 are used to control the bump or normal start of the saltwell pump. Latching relays are used so after the rungs become false the contacts associated with the latched or unlatched condition will remain either true or false until the latch relay condition is changed. The 10-minute timer contacts from ladder 5 are used since it monitors the injection water flow switch. When there is no or low injection water flow, the 10-minute timer-done contact in rung 1 is **TRUE** and the "bump or normal" relay is unlatched, thus forcing a bump start when the saltwell pump is started. In order for the saltwell pump to start, the injection water must return to normal and the 10-minute timer times out. This will cause the timer-done contact in rung 1 to become **FALSE** and the timer done contact in rung 0 to become **TRUE**. However, since the bump start has not occurred, the "bump to normal start" contact is **FALSE**, thus preventing the latching relay from becoming latched. The relay in rung 0 will become latched only after the bump sequence has occurred. Once the relay is latched, the associated contacts will remain in either their true or false condition until the injection water flow switch contacts open, resetting the 10-minute timer. Resetting the 10-minute timer will then cause rung 1 to become **TRUE** and forcing a bump start the next time the saltwell pump is started.

6.6.2 Rung 2 is the start control for the dilution system along with normal run relay for the saltwell pump for the 30-minute shutdown requirement for the injection pump after the saltwell pump shuts down. This rung can become true only after a bump start has been completed or if the saltwell pump has shutdown and restarted without injection water low flow opening. To explain the rung logic it is assumed the bump start is completed. Therefore, the N20:14/0 contact will be **TRUE** due to rung 0 having been **TRUE** after the bump sequence was completed. Assuming the interlock circuit (N20:17/3) and pump trouble (N20:24/4) interlocks are both **TRUE**, then the pump can be started. When the start is pressed at the DTAM screen, the N20:17/0 contact becomes **TRUE**, thus causing the dilution outputs and the reset relay to become **TRUE**. Upon closing of the motor starter contactor, the MR-1 contact will become **TRUE** and then the pump run output relay becomes **TRUE**. There is a second N20:17/0 contact in rung 6 for the actual starting of the saltwell pump. The pump run relay is used for the DTAM to monitor the pump run condition and in the injection pump control circuit. The reset relay becomes **TRUE** and makes its associated contact in rung 4 **TRUE**. With the interlock and pump trouble contacts **TRUE**, then the N20:17/0 output is **TRUE** and keeps rung 2 true. Should the interlock or pump trouble becoming false, then the N20:17/0 contacts in rungs 2 and 4 become **FALSE** stopping the dilution pumps. Should a stop command be received from the DTAM, then N20:17/0 becomes **FALSE** making the reset relay **FALSE** which in turn makes rung 4 false in both parallel paths.

6.6.3 Rung 3 is the bump permissive control. This rung becomes true when a bump start is required and the start input is received from the DTAM screen. The "bump start" contact is **TRUE** when the logic from rungs 0 and 1 are set for bump start. When the start contact from the DTAM becomes **TRUE**, the bump permissive becomes **TRUE** provided the interlock and trouble contacts are **TRUE**. The timer for Off-delay becomes **TRUE** and causes the timer contact in rung 4 to become **TRUE** to cause the motor start reset relay to become **TRUE**. The motor start reset relay is necessary for resetting the start command at the DTAM. Should the pump stop due to an interlock or pump trouble, the motor start reset relay becomes **FALSE** and makes the start from the DTAM contact **FALSE**. This prevents the pump from automatically restarting after the interlock or pump trouble clears. The Off-delay timer is used because during the transition from the bump to normal start, the bump permissive contact in rung 4 becomes **FALSE** and the seal-in contact becomes **TRUE** at approximately the same time. To ensure that the seal-in contact is true before the bump permissive becomes false, the bump permissive contact is delayed on changing to false by 0.02 seconds after the bump permissive rung 3 becomes false. The bump permissive rung when true, causes the bump permissive delay contacts in rungs 22 and 74 of ladder 5 become **FALSE** to disable the horn and shutdown output during the bump sequence. Should a fault occur such as a pump interlock break or pump trouble or should the start be aborted from the DTAM, the bump permissive rung will become **FALSE** and the contacts in rungs 22 and 74 of ladder 5 will become **TRUE** thus allowing the horn to sound and shutdown output to occur. The delay contact is used to prevent erroneous shutdown alarm and output during the switch from bump to normal start.

6.6.4 Rung 4 is the start reset logic. During a bump start the bump permissive contact is **TRUE** and during normal run mode the start reset contact is **TRUE**. As explained above, the restart output becomes **FALSE** during the bump start if the bump permissive goes false. When the N20:17/0 output becomes **FALSE**, then the N20:17/0 contacts become **FALSE**. This keeps the pump from automatically restarting when the fault is cleared. Once the pump shuts down from a fault, it must be restarted from the DTAM screen. During normal run mode, the bump permissive contact is **FALSE** and the start reset contact is **TRUE**. Therefore, if the pump shuts down during the normal run mode, the start reset again will become **FALSE** causing the N20:17/0 contact to become **FALSE**. A N20:17/0 contact is in series with the bump permissive delay contact to allow for manual shutdown from the DTAM screen. This contact is required because the delay contact will not open soon enough and the N20:17/0 output will put the DTAM input back to **TRUE**, thus keeping the bump start locked in. The interlock and pump trouble contacts are in this rung. Both must be **TRUE** to allow the saltwell pump to operate during bump and normal start and the dilution pumps to operate during normal start. Should either contact become false, the N20:17/0 output becomes **FALSE** and causes its associated contacts in rungs 2, 3, 4 and 6 to become **FALSE**. This will stop the pumps.

6.6.5 Rung 5 resets the bump sequence counter. The counter is always reset upon initial pass during subroutine 3. When the bump permissive is **FALSE**, the bump permissive contact in this rung is **TRUE** and the counter is reset. This counter counts the three cycles of the bump sequence.

6.6.6 Rung 6 starts the pump motor either during the bump sequence or for normal run mode. There are two parallel paths in this rung, one for bump start and the other for the normal run mode. First the bump path will be explained. The bump relay contact is controlled by rung 8. This contact is **TRUE** during the 1 second run time and becomes **FALSE** during the 10-second shutdown time during the bump sequence. The bump permissive contact is **TRUE** due to rung 3 being **TRUE**. Should an interlock or pump trouble fault occur, this bump permissive contact becomes **FALSE** to stop the bump start because rung 4 becomes false causing rung 3 to become false. When both the bump relay and bump permissive are true, then the MS-1 output is **TRUE** and 120vac is sent to the motor starter to start the pump. The other parallel path starts the pump during normal start sequence. The normal start contact N20:14/0 controlled by rungs 0 and 1 must be **TRUE** for a normal start to occur. During the bump sequence, the start-from-DTAM is already **TRUE**. Upon completion of the bump sequence, the N20:14/0 contact becomes **TRUE** and the pump normal starts.

Should the pump be shut down and the injection water flow remain closed, then the pump will start normal without going through the bump sequence when the start-from-DTAM is made **TRUE**.

6.6.7 Rungs 7 through 10 are the bump sequence control. There is a bump permissive contact in each rung. This is done so the bump start can be stopped any time during the sequence. In rungs 7, 8 and 10 the bump permissive contact is **TRUE** for bump starting to proceed and becomes **FALSE** when the bump sequence is completed or stopped. In rung 9 an opposite bump permissive contact is used. This contact is **FALSE** during the bump sequence and **TRUE** when the bump sequence is completed or stopped. This contact when true causes the bump relay to unlatch and be ready for the next bump start when called upon. The bump sequence functions as follows. When the pump motor is started in rung 6, the MR-1 contact becomes **TRUE** in rung 7 causing the 1 second timer to start and the counter to increase by 1. The MR-1 contact is used to ensure that the pump motor is actually started prior to starting the 1-second timer and counter. Upon the 1-second timer timing out, the timer-done contact in rung 8 becomes **TRUE** and starts the 10-second timer. The bump relay in rung 8 also becomes **TRUE** which makes the bump relay contact in rung 6 **FALSE** and stops the pump motor. The timer-done contact in series with the bump latch relay is **TRUE** because the timer has not timed out. The bump relay contact in parallel with the 1-second timer contact in rung 8 becomes **TRUE** and seals in the 10-second timer. This is required because when the pump motor stops, the MR-1 contact in rung 7 becomes **FALSE** causing the 1 second timer to reset which then causes the timer done contact in rung 8 to go **FALSE**. The bump relay makes the associated contact in rung 6 of ladder 5 becomes **FALSE** to bypass the pump trouble during the 10 second down time during bump sequence. Upon timing out of the 10-second timer, the timer done contacts in rungs 9 and 10 become **TRUE**. Either rung 9 or 10 will become true depending upon whether the counter is at 3 or less than 3. If the counter in rung 7 is at 1 or 2, then rung 9 is **TRUE** because the counter-done contact is **TRUE** and the bump relay is unlatched causing the contact in rung 6 to become **TRUE** to start the pump again. The unlatching is allowed because the timer done contact in rung 8 is **FALSE** due to the 10-second timer timing out. The bump relay contact in rung 6 of ladder 5 become **TRUE** again to reactivate the pump trouble. When the bump relay becomes unlatched, its associated contact in rung 8 becomes **FALSE** and the 10-second timer is reset. When the counter in rung 7 is at 3, the counter done contact in rung 9 becomes **FALSE** and the counter done contact in rung 10 becomes **TRUE**. Timing out of the 10 second timer then causes rung 10 to become **TRUE** and the to normal start" relay is made **TRUE** which makes the associated contact in rung 0 **TRUE**. Rung 0 now becomes **TRUE**. This is allowed because the 10 min delay contact is **TRUE** due to the flow switch indicating proper flow and rung 1 being false so the relay in rung 0 can be latched. Upon rung 0 being true, the relay latches, the associated contacts in rung 2 and rung 6 become **TRUE,** and the associated contact in rung 3 becomes **FALSE**. The contact in rung 3 makes the bump permissive **FALSE** which in turn enables the horn and shutdown output in ladder 5, unlatches the bump relay in rung 9, and resets the counter through rung 5. Rung 2 will cause the dilution system to start up and rung 6 will cause the pump motor to start. Since the bump to normal start relay in rung 0 is a latching relay, the pump can be normal started after a shutdown provided the injection flow remains such that the flow switch does not drop out. If the flow switch drops out, then the N20:14/0 relay will be unlatched in rung 1 and a bump start will be required.

6.6.8 Rungs 11 and 16 are for the injection pump control. Rung 11 monitors the run status of the injection pump. The N60:20/6 contact is **TRUE** when the pump is running, thus starting the 10-minute timer. This 10-minute timer corresponds to the 10-minute timer in ladder 5 for the flow switch and is used to control the injection control relay in rung 12. Rung 12 is the injection shutdown control. The injection pump will **always** be started prior to the saltwell pump starting. Therefore, the N20:14/7 contact will be **FALSE**, resetting the 30-minute timer and causing the timer-done contact T4:94/DN to be **TRUE**. The high transfer pressure contact, N20:14/9 must be **TRUE** to allow the injection pump to start by output N60:20/1 being **TRUE**. Once the injection pump starts, the 10-minute timer in rung 11 starts. Upon timing out, the associated 10-minute timer contact in rung 12 becomes **TRUE** making the injection control relay **TRUE**. The corresponding injection control contact in rung 12 becomes **TRUE** and will start the 30-minute timer. The 30-minute timer will start because the saltwell pump is not ON making the normal run contact N20:14/7 **TRUE**. If the saltwell pump is not started before the 30-minute timer times out, the injection pump will shut down. This injection pump shutdown occurs because the associated 30-minute timer contact in rung 12 becomes **FALSE** making the injection pump output **FALSE** which stops the injection pump. At the same time, the injection control relay becomes **FALSE**, which in turn causes the associated contact in rung 12 to become **FALSE** causing the 30-minute timer to reset. Resetting of the 30-minute timer causes the associated timer contact in rung 12 to become **TRUE** again, allowing the injection output to become **TRUE**. This allows for restarting of the injection pump. When the saltwell pump starts before the 30-minute timer times out, the pump normal run contact in rung 12 becomes **FALSE** and the 30-minute timer resets. Should the saltwell pump later shut down, the pump normal run contact in rung 12 will become **TRUE,** causing the 30-minute timer to start. If the saltwell pump is not restarted within 30 minutes, the injection pump will shut down upon timing out of the 30-minute timer. Rungs 13 through 16 are for shutting down the injection pump upon the saltwell pump shutting down due to a high-pressure transfer trip. The high-pressure contact in rung 13 is **TRUE** upon high pressure, thus causing latch relay N20:14/10 to become **TRUE**. A latching relay is used since once the saltwell pump stops, the high-pressure decays causing the high-pressure contact to become **FALSE** again. The associated latch relay contact in rung 14 becomes **TRUE** when the latch relay is true, thus starting the 5-second timer. A 5-second timer is used to allow pressure decay to occur before shutting down the injection pump to prevent waste material from entering the injection pump bearing cavities. Upon timing out of the 5-second timer, rung 15 becomes **TRUE** and the corresponding contact of N20:14/9 in rung 12 becomes **FALSE** to cause the injection pump output to become **FALSE** causing the injection pump to stop running. Once the injection pump stops and the high transfer pressure clears, rung 16 becomes **TRUE** to unlatch the transfer pressure relay. The unlatching causes the associated contact in rung 14 to become **FALSE** to reset the 5-second timer which in turn causes the timer-done contact in rung 15 to become **FALSE**. When rung 15 becomes false, the high-pressure contact in rung 12 becomes **TRUE** to allow the restarting of the injection pump.

6.7 Ladder 9 has new rungs 4 through 7 added. These rungs are similar to rungs 0 through 3 for the jumper heat trace control. Rungs 4 through 7 control the pump piping assembly heat trace. A screen on the DTAM is provided to enter the temperature setpoint that is stored in file N31:17. The temperature is read into address N60:34.

6.8 Ladders 17 and 18 have tags changed to reflect the changing of the alarms. No logic changes have been made.

6.9 Ladder 19. An output rung is added for module 6. Outputs of address N60:20 are sent to the data 6 module outputs.

6.10 Ladder 20 is totally revised to use floating-point data entry and to account for the injection water being added into the pumping system.

6.11 Ladder 21 is a new subroutine for calculating the volume of injection water to the new saltwell pump. Two assumptions used in this routine are that the water flow remains constant and that the nearest whole gallon readout is sufficient. The volume readout is provided on a DTAM screen in gallons. The routine used is similar to the total value calculated for the waste volume from gathering the flow rate from the flow meter. This method is used because it is assumed that more than 32,767 gallons will be used which is the maximum number that can be stored in any file in the PLC. A larger value will cause an error in the PLC program. The main difference is the flow meter is sending out a 4 to 20mA signal. Here a discrete signal is used to start the process. The calculation functions as follows.

6.11.1 Rung 0 starts the subroutine when the injection water flow switch closes making contact N60:30/10 **TRUE**. The 60-second retentive timer starts. A retentive timer is used because if the flow switch opens during the timer-timing phase the time is kept. This prevents any flow data from being lost due to the timer being reset during the timing phase. Since the flow rate used in the calculation is a value entered in at the DTAM in gallons per minute, the 60 seconds makes the calculation easy by simply adding the flow rate every minute.

6.11.2 Rung 1 becomes **TRUE** when the 60-second timer times out. The flow rate that is stored in file F90:3 (the value entered from the DTAM screen) is added to the accumulative value file F90:1 and then stored back into the same file F90:1.

6.11.3 Rung 2 resets the 60-second timer.

6.11.4 Rung 3 becomes **TRUE** when the accumulative value in file F90:1 is equal to or greater than one. When this occurs, one is subtracted from the accumulative value and the result stored back into the accumulative file. At the same time the C5:4 counter is increased by one. When counter C5:4 becomes 10,000, then the C5:4-done contact become **TRUE** causing counter C5:5 to increase by one and resetting the C5:4 counter back to zero.

6.11.5 Rung 4 resets the C5:5 counter should it ever reach 10,000.

6.11.6 Rung 5 resets the entire volume calculation routine back to zero. This can only be done from the DTAM through a restricted screen. Rung 6 is part of the reset where a zero is placed in address N20:14/1 after the reset takes place. This is necessary to prevent rung 5 from continually resetting since once N20:14/1 is made **TRUE** at the DTAM it will remain true until an action occurs to make the address false. When rung 5 becomes true, then relay N20:14/5 becomes **TRUE**. This in turn makes the associated contact in rung 6 **TRUE** initiating the zero move to N20:14/1. After N20:14/1 becomes **FALSE** with the zero, the N20:14/5 relay goes **FALSE** thus make the associated contact in rung 6 **FALSE**.

6.11.7 Rung 7 returns the subroutine back to ladder 2.

6.12 Here is an example of the above subroutine. Assume a flow rate value entered at the DTAM is 0.35gpm, F90:1 is at zero and the counters are at zero. When the flow switch closes, the timer starts. After 60 seconds 0.35 is added to the F90:1 file and stored there. The timer is reset and after the next 60 seconds 0.35 is added to the F90:1 file making the stored accumulative value 0.70. The next 60 seconds increases the accumulative value to 1.05. This causes rung 3 to function because the accumulative value is greater than 1. One is subtracted from the accumulative value and the result of 0.05 is stored in the F90:1 file. The counter increases to 1. At this point the DTAM screen that displays the injection water volume will indicate 1 gallon. The process will continue as described. When the first counter counts 10,000, then the second counter counts one and the first counter is reset to zero. The DTAM screen is set to read just four places for each counter. Therefore the value at the DTAM will be 10000.

7.0 DTAM PROGRAM CHANGES

7.1 The DTAM which is the operator interface to the PLC required changes to incorporate the bump start, injection pump starting, heat trace control changes, injection flow rate setting, and injection water volume total. The following describes the screen changes made to the DTAM program.

7.1.1 Existing screen 6 is changed to a data display screen to show the status of the injection pump on the DTAM. The screen monitors the output address to the injection pump to display whether the injection pump is ON or OFF.

7.1.2 Screen 8 has the motor temperature submenu item removed. Three submenu items 2 through 4 are inserted for the injection pump. Item 2 is for the injection pump run status; item 3 goes to the data entry screen to set the injection flow rate; and item 4 goes to the injection volume submenu.

7.1.3 Screen 9, which is a security screen, has the previous menu link changed to the screen 8 submenu. This screen is used to protect the injection flow rate setting from being changed other than by authorized personnel.

7.1.4 The saltwell pump start screen 11 is modified because of the new bump start sequence being added. The screen displays pump normal start and bump start. The pump starting entry remains the same. The pump normal start displays reads the pump run relay address that is **TRUE** only when the motor starter contactor is closed. The bump start display reads the bump permissive address.

7.1.5 Screens 20 and 37 are modified to include the flush water temperature display. Screen 37 is also modified to display the maximum dilution flow in a decimal value.

7.1.6 Screen 25 is changed to show the pump piping assembly temperature.

7.1.7 Screens 29 and 44 were modified to include the motor winding temperature display. Screen 29 is also modified to show the minimum dilution flow in a floating-point decimal value.

7.1.8 The title of submenu screens 30 and 31 were changed to "Heat Trace" since both the jumper and pump piping heat trace controls are included.

7.1.9 Screen 34 has a maximum dilution flow item added to the submenu and referenced to screen 80.

7.1.10 Screen 36 is revised for the minimum dilution value to be displayed as a floating decimal value.

7.1.11 Existing screen 38 was changed to be a data entry screen for the injection flow rate. The existing flow rate value is displayed for operator benefit. The data entry is limited to entry values between 0.3 and 1.0 with a default value of 0.301.

7.1.12 Existing screen 39 was changed to a data display screen for the injection water flow rate and total volume. The flow rate is displayed as a floating-point decimal value. This screen reads the two counter accumulation files in subroutine 21 in the PLC program for the volume. The display is arranged to read the first four digits in each file and can display an eight-figure volume value. The read out is to the nearest whole gallon.

7.1.13 Screen 53 was modified to include the power monitor and low injection water flow alarm message.

7.1.14 Screen 58 was modified to include the pump bearing and motor winding temperature alarm message.

7.1.15 New screen 80 is added for entering the maximum dilution ratio value.

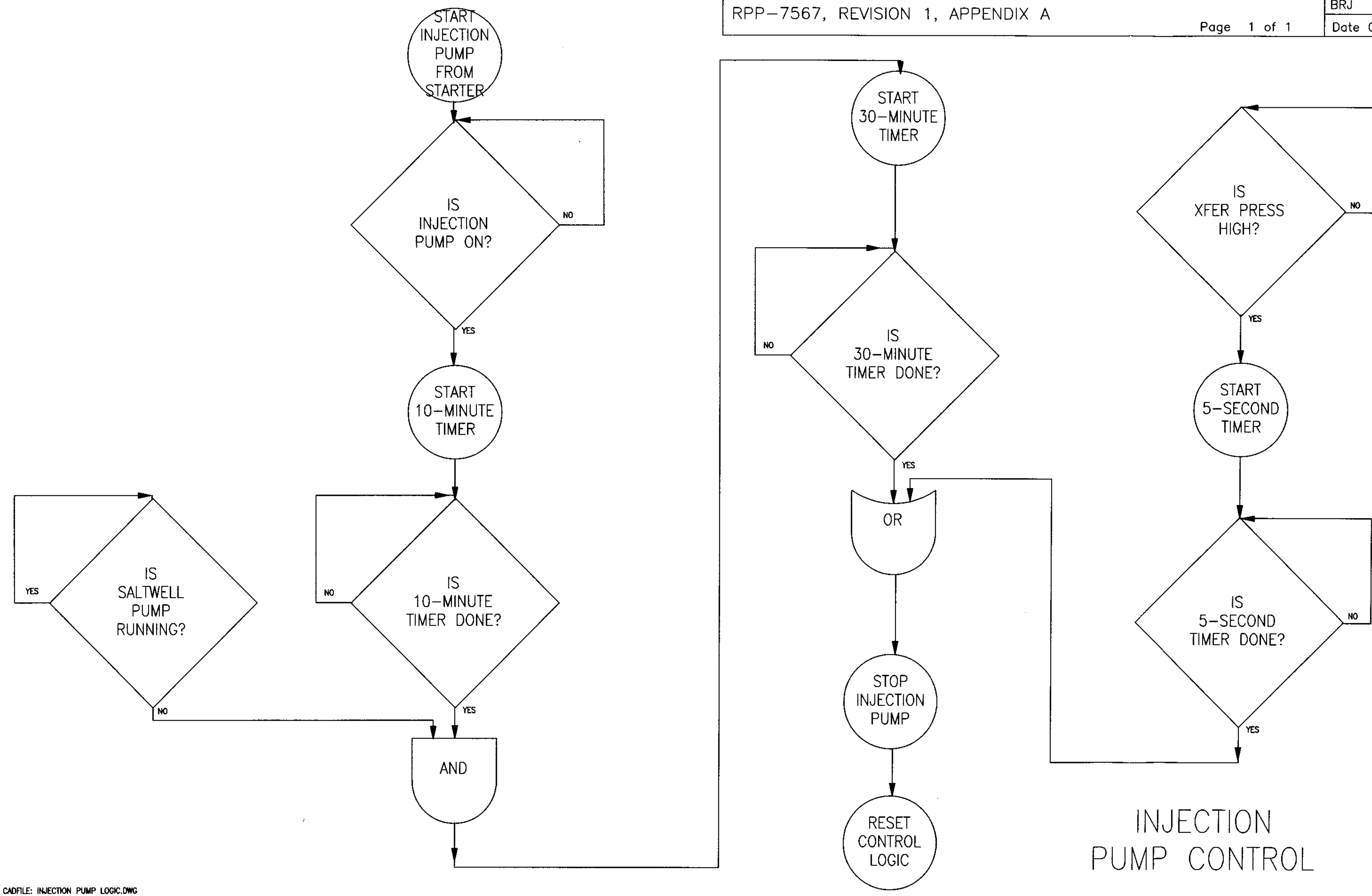
7.1.16 New screens 82, 84 and 85 are added for the heat trace control. Screen 82 displays the setpoints for the jumper and pump piping assembly heat trace. Screen 84 is a data entry screen for setting the pump piping assembly heat trace setpoint. (The jumper heat trace setpoint screen already exists.) Screen 85 is a submenu screen for selecting the heat trace setpoint or display screens.

7.1.17 New screens 83, 86 and 87 are added for the injection water volume total. Screen 83 is a submenu for either selecting either to view the total volume or resetting the volume back to zero. Screen 86 is a security screen to protect the volume resetting. Only authorized personnel can go in and reset the volume back to zero. Screen 87 is the reset screen. Pressing 1 will reset the volume back to zero.

7.1.18 Alarm screen 114 revised for motor winding high temperature shutdown.
7.1.19 Alarm screen 139 revised for injection water low flow.
7.1.20 Alarm screen 140 revised for the power monitor high or low shutdown.
7.1.21 Alarm screen 158 revised for pump worn bearing alert.
7.1.22 Alarm screen 159 revised for bearing approach to high temperature shutdown.

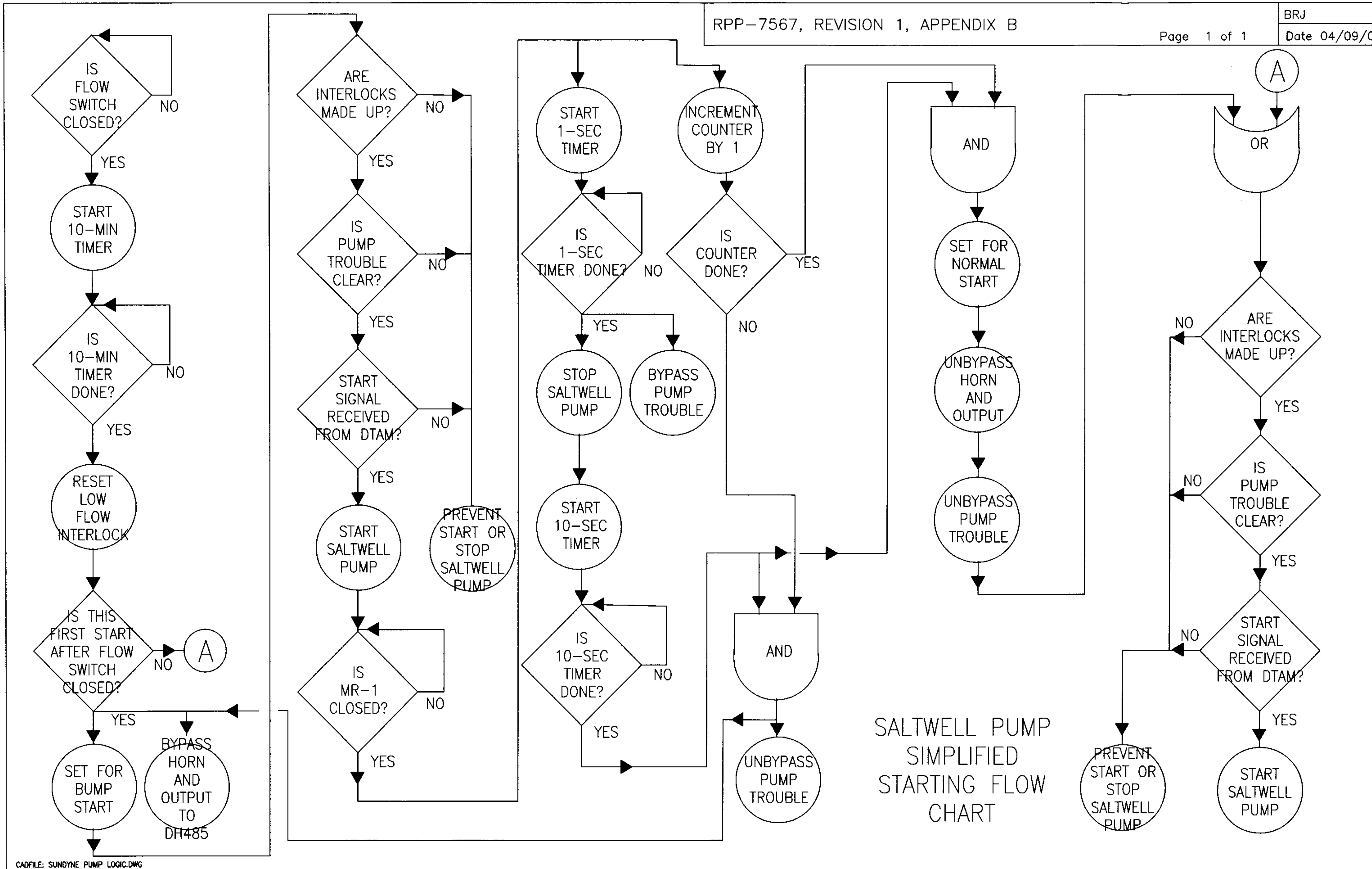
8.0 APPENDICES

8.1 APPENDIX A: INJECTION PUMP CONTROL
8.2 APPENDIX B: SALTWELL PUMP SIMPIFIED STARTING FLOW CHART
8.3 APPENDIX C: DILUTION FLOW SUBROUTINE
8.4 APPENDIX D: PLC LADDER LOGIC
 8.4.1 LADDER 2: PARTIAL
 8.4.2 LADDER 3: PARTIAL
 8.4.3 LADDER 4: PARTIAL
 8.4.4 LADDER 5: COMPLETE LADDER
 8.4.5 LADDER 7: PARTIAL
 8.4.6 LADDER 9: COMPLETE LADDER
 8.4.7 LADDER 19: COMPLETE LADDER
 8.4.8 LADDER 20: COMPLETE LADDER
 8.4.9 LADDER 21: COMPLETE LADDER

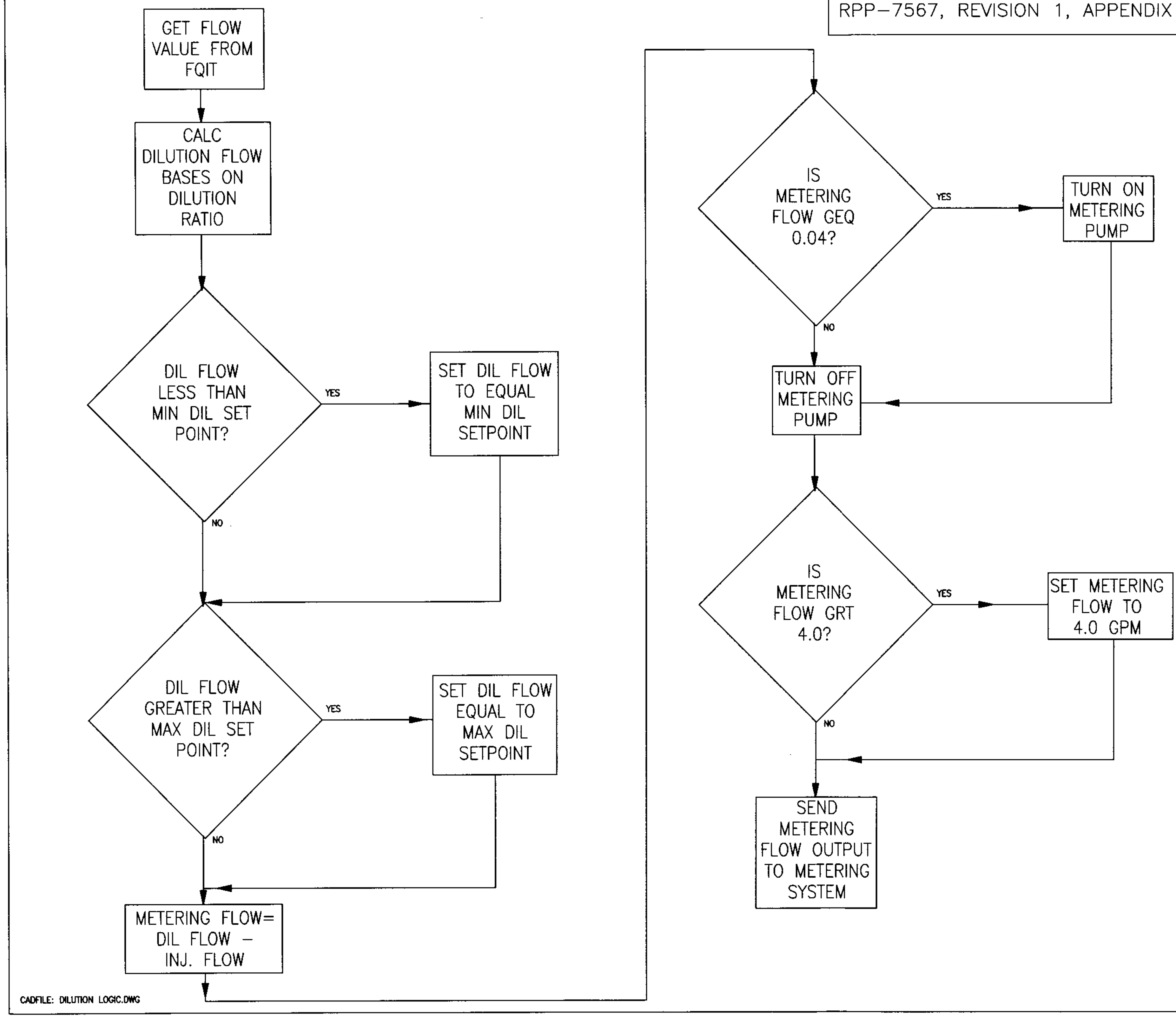


INJECTION PUMP CONTROL

CADFILE: INJECTION PUMP LOGIC.DWG



SALTWELL PUMP SIMPLIFIED STARTING FLOW CHART



DILUTION FLOW SUBROUTINE

LAD 2 - --- Total Rungs in File = 19

GO TO FLOW METER ROUTINE WHEN PUMP ON AND INPUT TO FLOW METER IS GREATER THAN 4 mA

1 SEC DELAY

0010 T4:33 DN — GRT Greater Than (A>B) Source A N60:15 3281< Source B 3277 3277< — JSR Jump To Subroutine SBR File Number U:13

T4:33 RES

NETWORK INTERLOCK

0011 JSR Jump To Subroutine SBR File Number U:15

INDIVIDUAL ALARM ACKNOWLEDGE

0012 JSR Jump To Subroutine SBR File Number U:17

OUTPUT TO STROBE AND LIGHTS AND HORN

0013 JSR Jump To Subroutine SBR File Number U:18

DILUTION SYSTEM ROUTINE

0014 JSR Jump To Subroutine SBR File Number U:20

SEND OUTPUTS

0015 N20:17 7 — JSR Jump To Subroutine SBR File Number U:19

CALCULATE INJECTION WATER VOLUME IN GALLONS

0016 JSR Jump To Subroutine SBR File Number U:21

RESET TOTALIZER (FLOW METER)

0017 N20:17 5 — CLR Clear Dest C5:1.ACC 9233<

CLR Clear Dest C5:2.ACC 0<

0018 END

LAD 3 - --- Total Rungs in File = 20

INITIALIZE THERMOCOUPLE MODULES IN SLOTS 7 AND 12

0000 SBR Subroutine — COP Copy File Source #N9:0 Dest #O:7.0 Length 4 — COP Copy File Source #N9:0 Dest #O:12.0 Length 4

0001 MOV Move Source 0 0< Dest N13:0 0<

0002 NOT NOT Source N13:0 0< Dest N13:1 -1<

0003 MOV Move Source 16 16< Dest N15:8 0<

0004 MOV Move Source 2 2< Dest N15:7 2<

0005 B3:7 (U) 6

UNLATCH RELAY TO FORCE BUMP START UPON INITIAL STARTING OF THE PLC.

0006 BUMP OR NORMAL START RELAY N20:14 (U) 0

0007 BUMP UNLATCH RELAY N20:14 (U) 4

0008 COUNTER RESET C5:3 (RES)

0009 MVM Masked Move Source N13:0 0< Mask 0002h 2< Dest N20:14 -28992<

SKID P, NODE 2, A-101

0010 MOV Move Source 2 2< Dest N7:50 0< — Node Address/ Baud Rate MVM Masked Move Source N7:50 0< Mask 00FFh 255< Dest S:15 1026<

0011 JSR Jump To Subroutine SBR File Number U:10

0012 CLR Clear Dest N20:32 516< — MOV Move Source N13:1 -1< Dest N40:15 516<

0013 CLR Clear Dest N15:2 0<

LAD 4 - --- Total Rungs in File = 11

GET INPUTS FROM MODULES 1, 2 AND 3

0000 SBR Subroutine

COP Copy File Source #I:1.0 Dest #N60:2 Length 2

COP Copy File Source #I:2.0 Dest #N60:6 Length 2

COP Copy File Source #I:3.0 Dest #N60:10 Length 2

GET INPUTS FROM MODULES 4 AND 5

0001

COP Copy File Source #I:4.0 Dest #N60:12 Length 4

COP Copy File Source #I:5.0 Dest #N60:16 Length 4

GET INPUTS FROM MODULE 6

0002

MVM Masked Move Source I:6.0 0< Mask 003Fh 63< Dest N17:8 0<

MUL Multiply Source A N17:8 0< Source B 64 64< Dest N17:9 0<

MVM Masked Move Source N17:9 0< Mask 0FC0h 4032< Dest N60:20 -1<

GET TEMPERATURE INPUTS FROM MODULE 7

0003

COP Copy File Source #I:7.0 Dest #N60:24 Length 4

GET INPUTS FROM MODULE 8

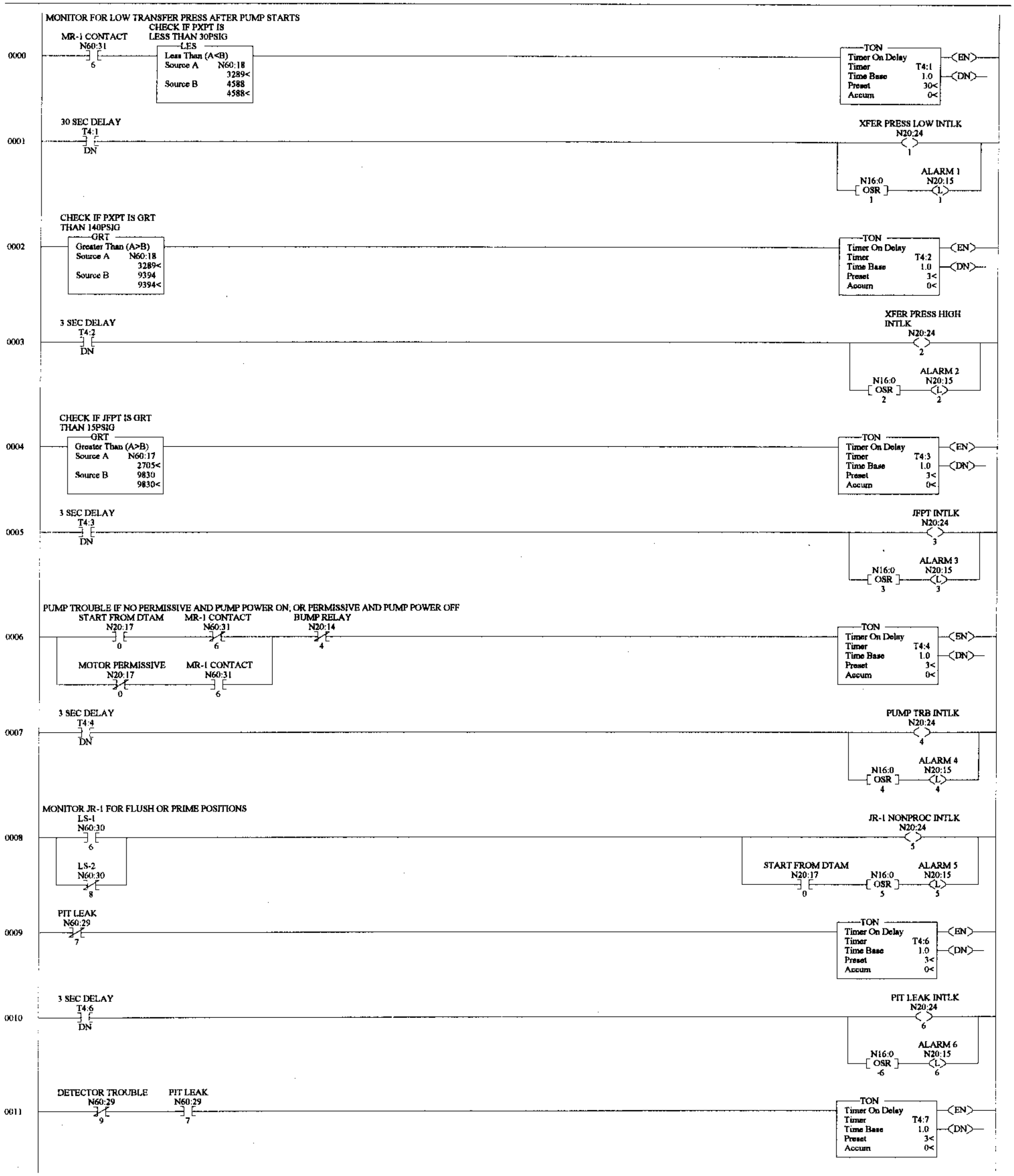
0004

MVM Masked Move Source I:8.0 54< Mask 003Fh 63< Dest N17:0 54<

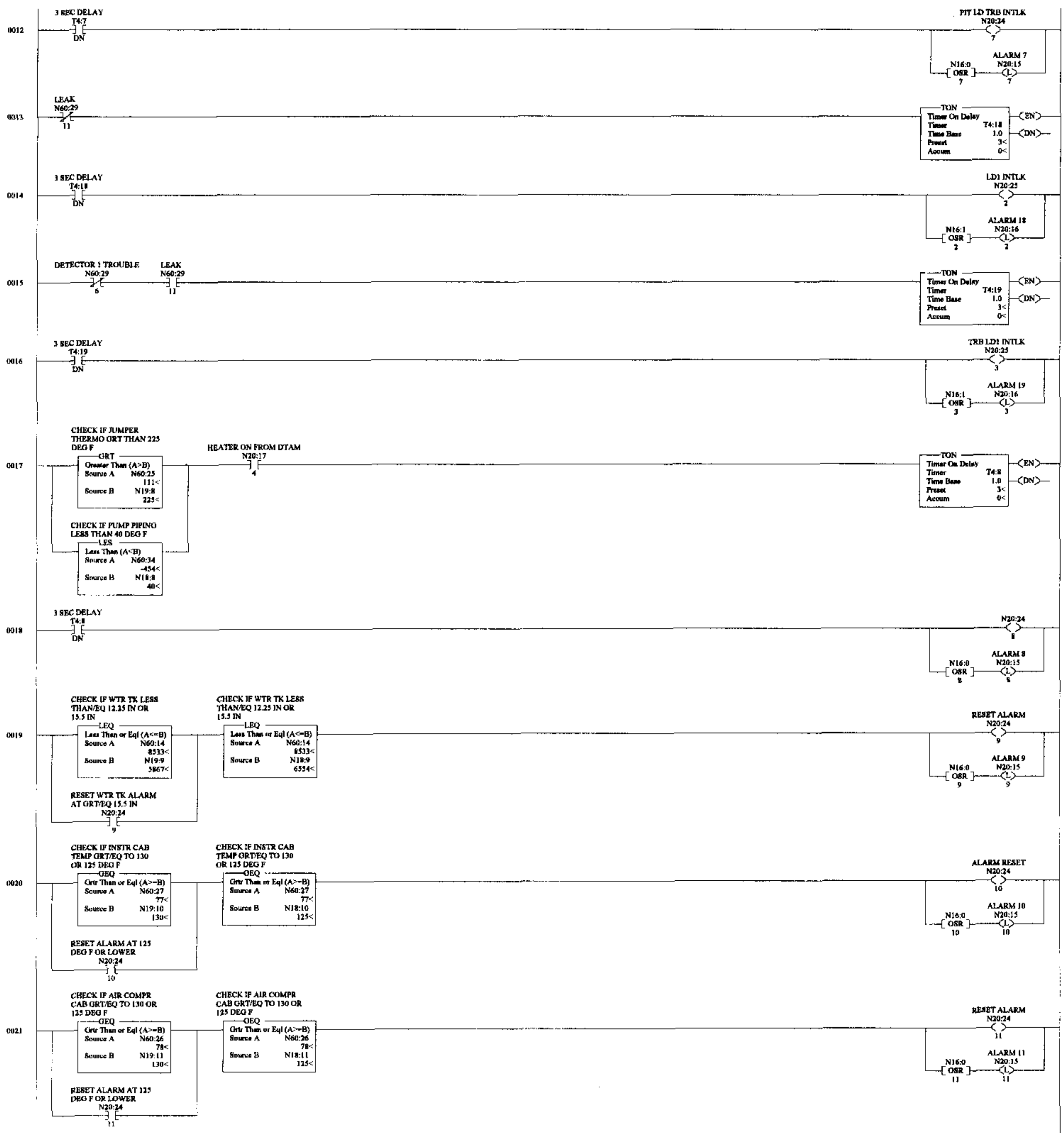
MUL Multiply Source A N17:0 54< Source B 64 64< Dest N17:1 3456<

MVM Masked Move Source N17:1 3456< Mask 0FC0h 4032< Dest N60:28 3072<

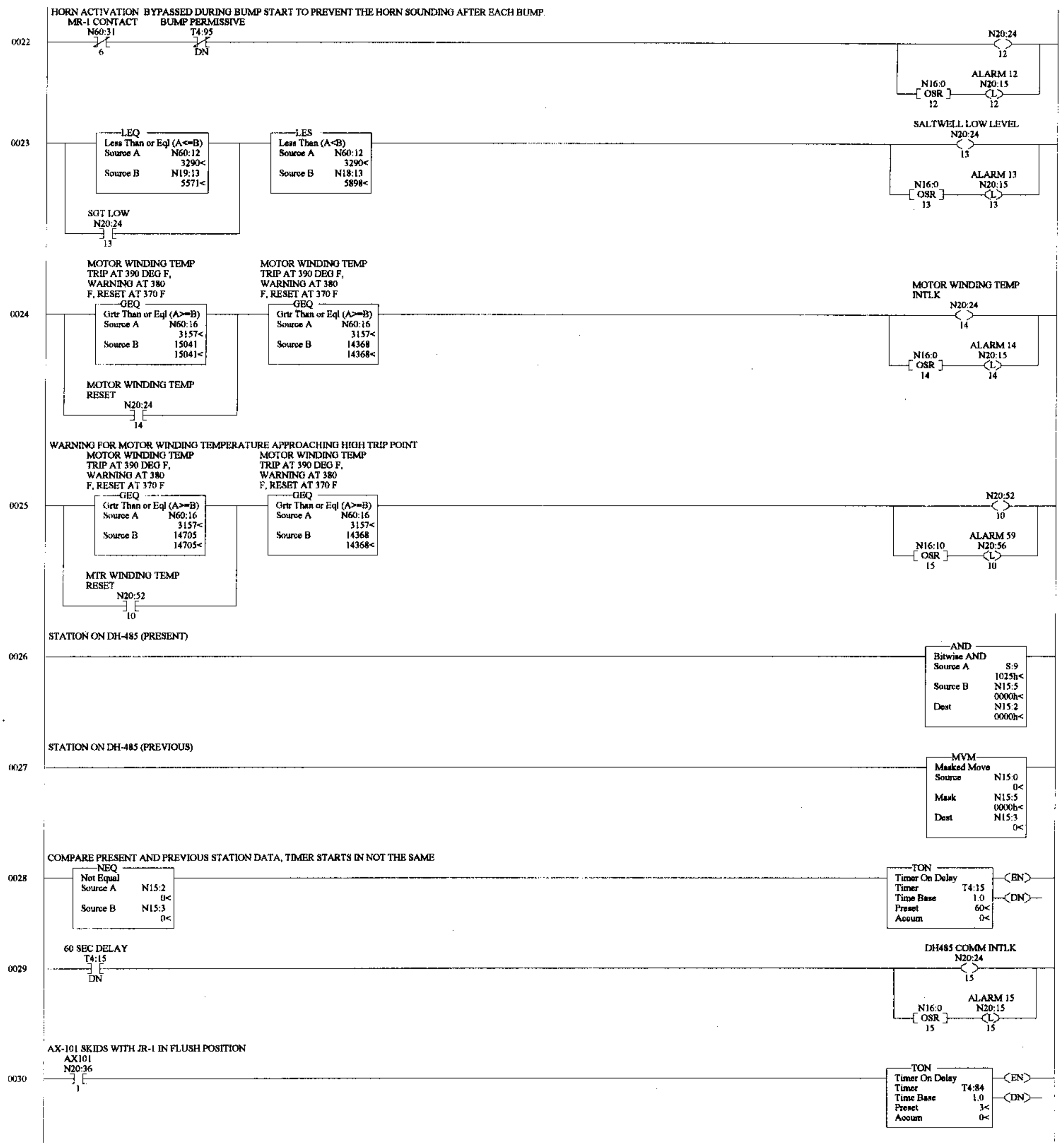
LAD 5 - --- Total Rungs in File = 83



LAD 5 - --- Total Rungs in File = 83



LAD 5 - --- Total Rungs in File = 83



LAD 5 - --- Total Rungs in File = 83

0031
3 SEC DELAY
T4:84
DN
OTHER SKID IN FLUSH INTLK
N20:25
4
N16:1
OSR
4
ALARM 20
N20:16
L
4

0032
CHECK IF JFPT SIGNAL LESS THAN 4mA
LES
Less Than (A<B)
Source A N60:17
2705<
Source B 2500
2500<
TON
Timer On Delay
Timer T4:10
Time Base 1.0
Preset 3<
Accum 0<
EN
DN

0033
3 SEC DELAY
T4:10
DN
JFPT SIGNAL LOSS INTLK
N20:25
0
N16:1
OSR
0
ALARM 16
N20:16
L
0

0034
AX-101 SKID WITH PIT LEAK ALARM
AX-101 LEAK
N20:36
3
TON
Timer On Delay
Timer T4:17
Time Base 1.0
Preset 3<
Accum 0<
EN
DN

0035
3 SEC DELAY
T4:17
DN
AX101 SKID LEAK INTLK
N20:25
1
N16:1
OSR
5
ALARM 17
N20:16
L
1

0036
GET ALL ACTIVE NODES
MOV
Move
Source S:9
4133<
Dest N20:27
4133<

0037
CHECK IF LEAK STATION 1 ON LINE
AND
Bitwise AND
Source A N20:27
1025h<
Source B 4096
4096<
Dest N30:10
1000h<

0038
LEAK STATION 1 TROUBLE
EQU
Equal
Source A N30:10
4096<
Source B 0
0<
TON
Timer On Delay
Timer T4:79
Time Base 1.0
Preset 3<
Accum 0<
EN
DN

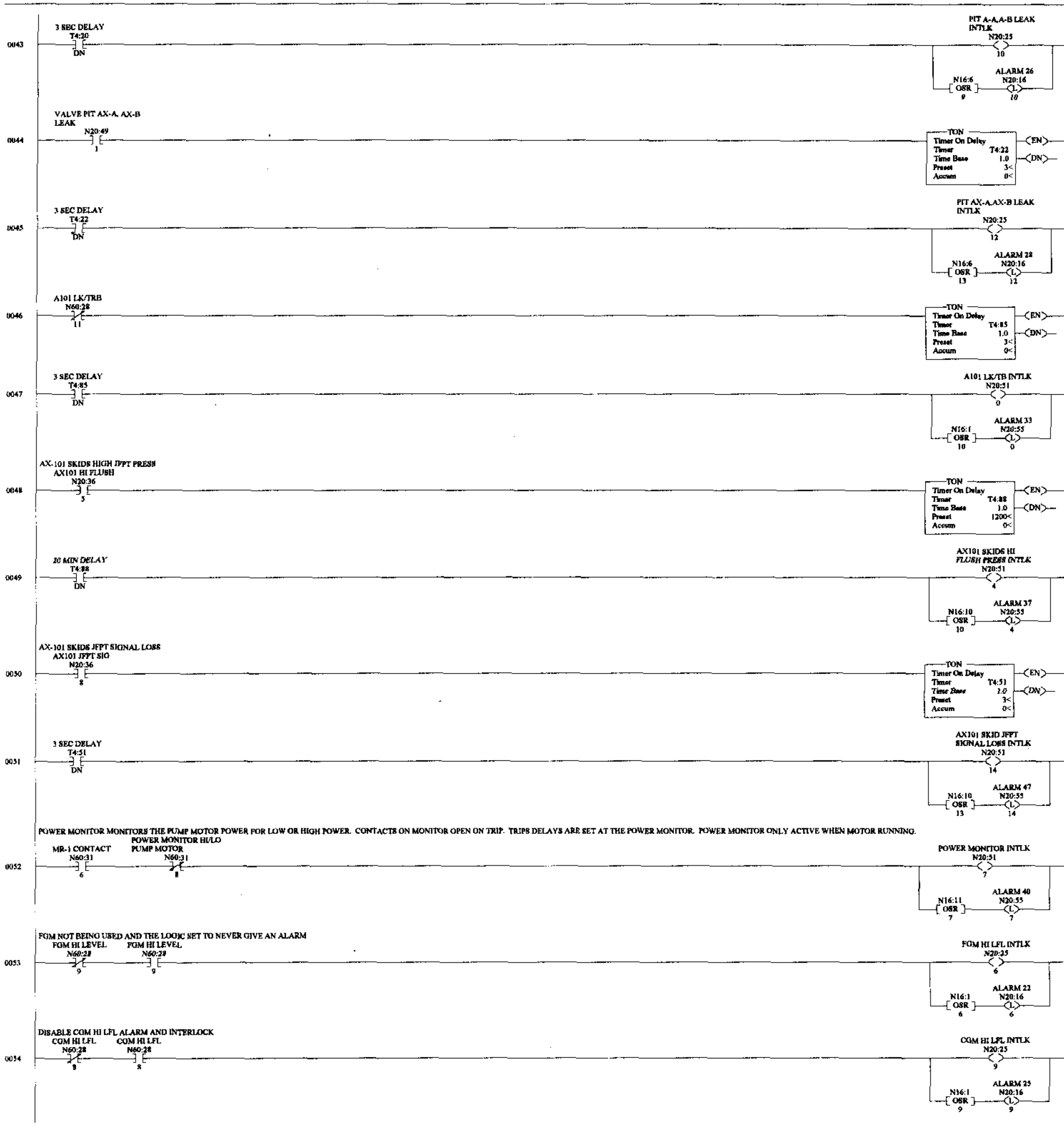
0039
3 SEC DELAY
T4:79
DN
LEAK STATION 1 TRB INTLK
N20:25
7
N16:1
OSR
7
ALARM 23
N20:16
L
7

0040
AN-101 LEAK OR TROUBLE
AN101 SIG
N60:28
6
TON
Timer On Delay
Timer T4:26
Time Base 1.0
Preset 3<
Accum 3<
EN
DN

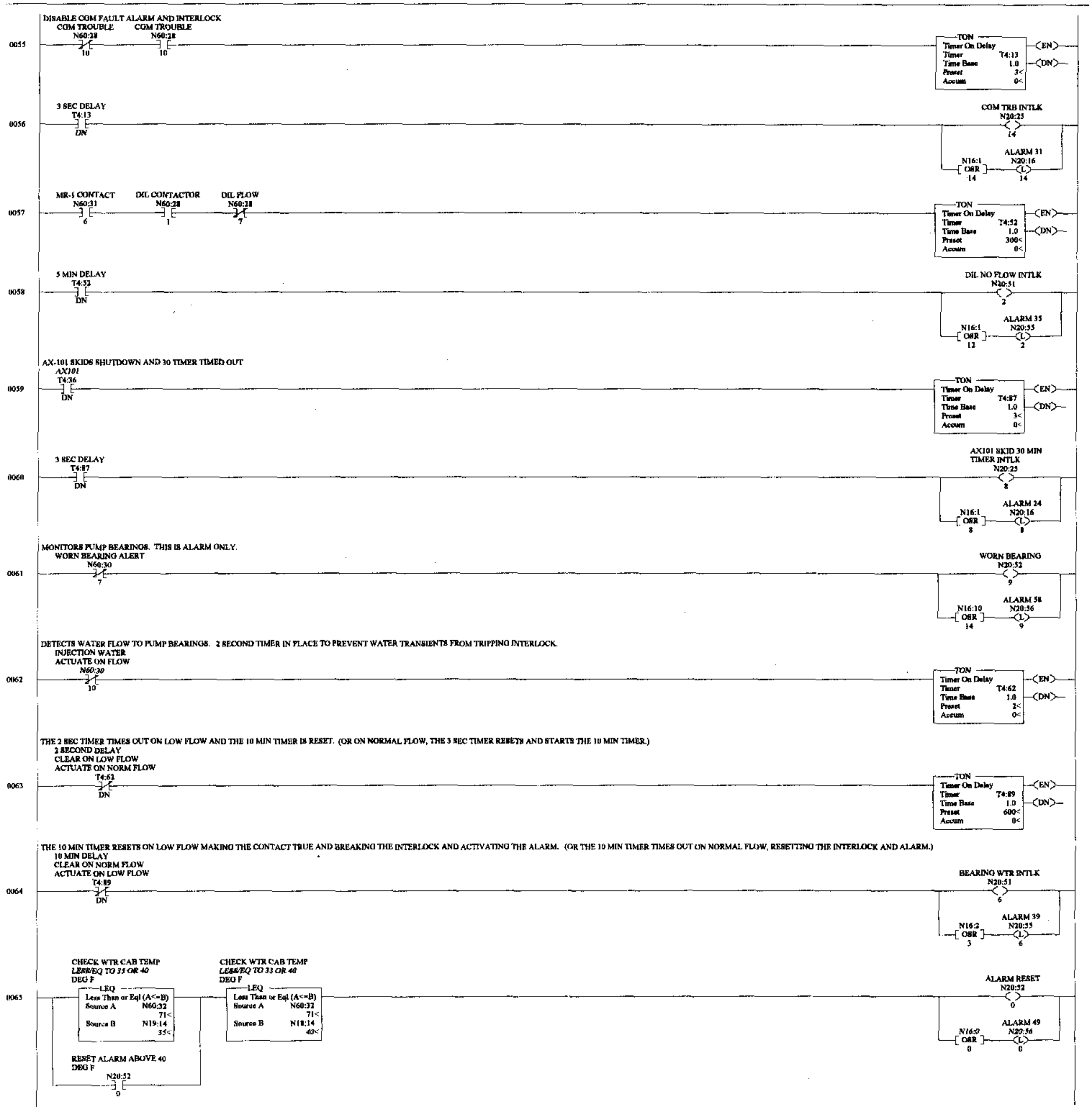
0041
3 SEC DELAY
T4:26
DN
AN101 LK/TRB INTLK
N20:25
15
N16:7
OSR
8
ALARM 32
N20:16
L
15

0042
VALVE PIT A-A,A-B LEAK
N20:49
0
TON
Timer On Delay
Timer T4:20
Time Base 1.0
Preset 3<
Accum 0<
EN
DN

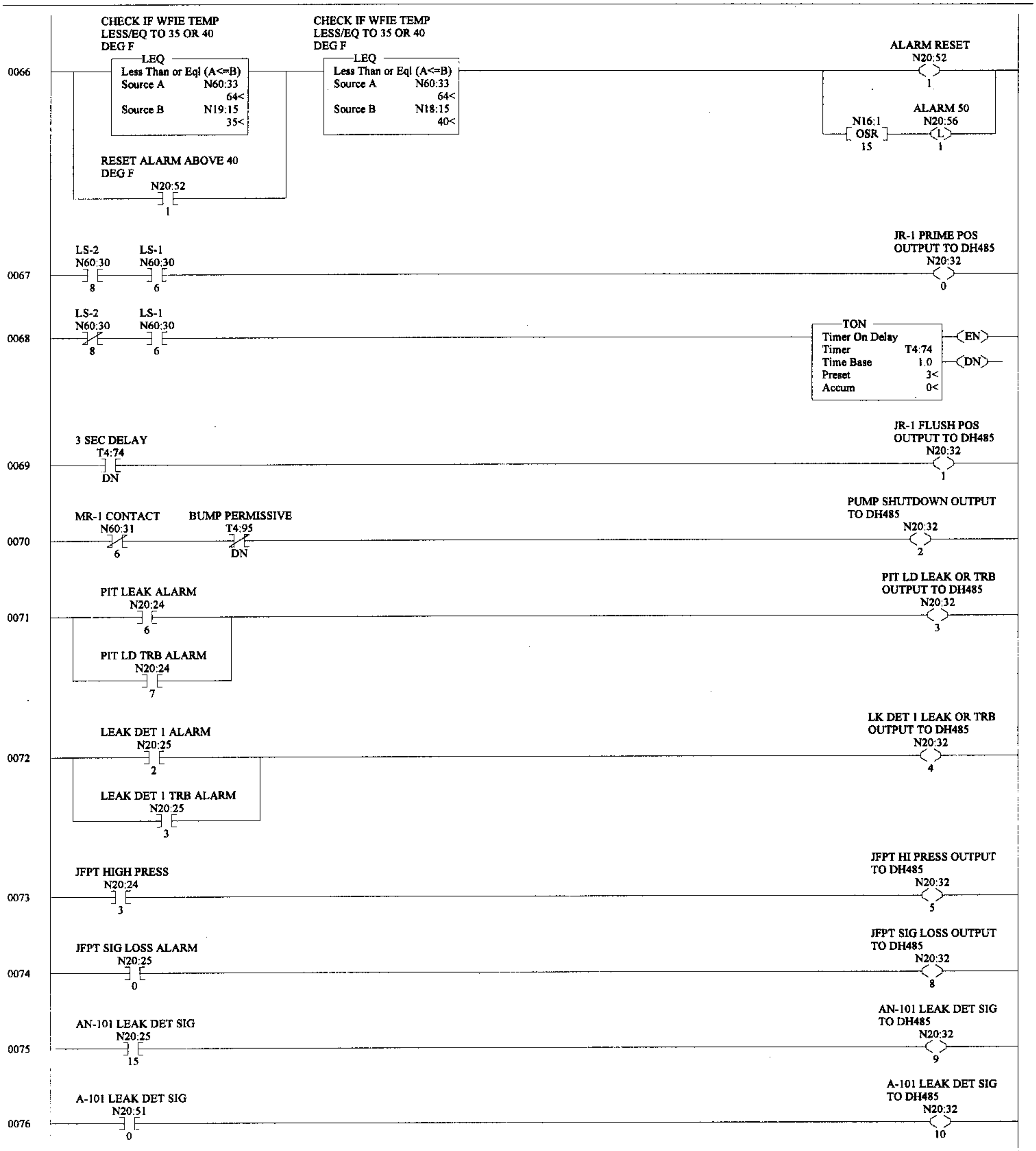
LAD 5 - --- Total Rungs in File = 83



LAD 5 - --- Total Rungs in File = 83



LAD 5 - --- Total Rungs in File = 83



LAD 5 - --- Total Rungs in File = 83

INPUT TO WONDERWARE

0077

NEQ
Not Equal
Source A N20:15
0<
Source B N13:0
0<

NEQ
Not Equal
Source A N20:16
0<
Source B N13:0
0<

NEQ
Not Equal
Source A N20:55
0<
Source B N13:0
0<

NEQ
Not Equal
Source A N20:56
0<
Source B N13:0
0<

FLASH FOR ALARM CONDITIONS
N20:17
( )
9

INPUT TO WONDERWARE

0078

NEQ
Not Equal
Source A N20:24
12288<
Source B N13:0
0<

NEQ
Not Equal
Source A N20:25
-32256<
Source B N13:0
0<

NEQ
Not Equal
Source A N20:51
0<
Source B N13:0
0<

NEQ
Not Equal
Source A N20:52
0<
Source B N13:0
0<

COLOR CHANGE FOR ALARM CONDITIONS
N20:17
( )
13

JET PUMP MOTOR INTERLOCK CIRCUIT

0079

XFER PRESS LOW	XFER PRESS HIGH CLEARED	JFPT	JR-1 FLUSH	PIT LEAK	MTR WINDING TEMP	DH485 COMM FAILURE	JFPT SIGNAL LOSS
N20:24	N20:24	N20:24	N20:24	N20:24	N20:24	N20:24	N20:25
1	2	3	5	6	14	15	0

PWR MONITOR	FGM HI LFL	LD#1 LEAK	N20:17
N20:51	N20:25	N20:25	( )
7	6	2	1

0080

INJ WTR FLOW SW	SUB-INTERLOCK	SUB INTERLOCK	CGM HI LFL	CGM TRB	PIT LD TRB	LD#1 TRB	MOTOR PERMISSIVE
N20:51	N20:17	N20:17	N20:25	N20:25	N20:24	N20:25	N20:17
6	1	2	9	14	7	3	( ) 3

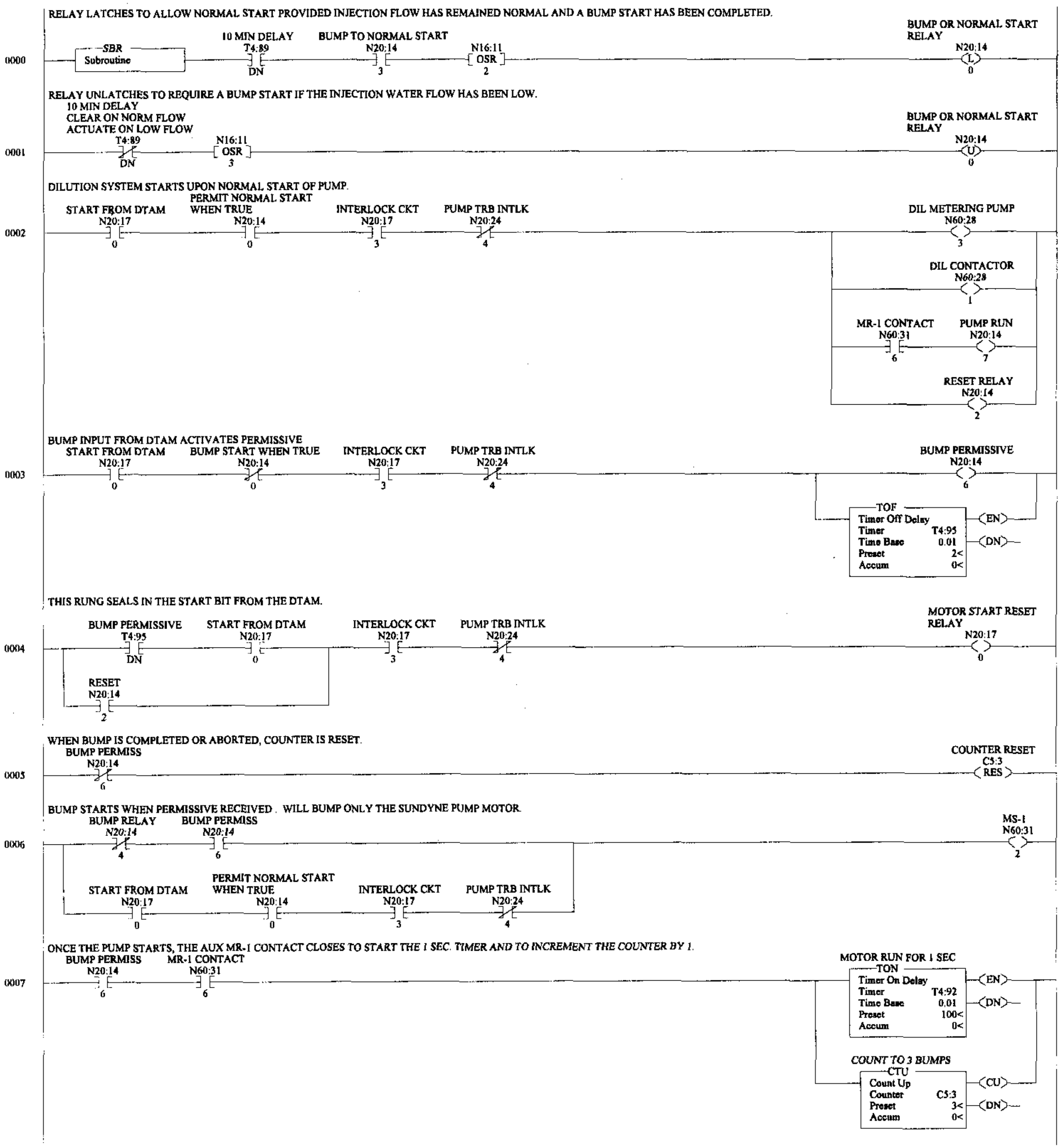
0081

RET
Return

0082

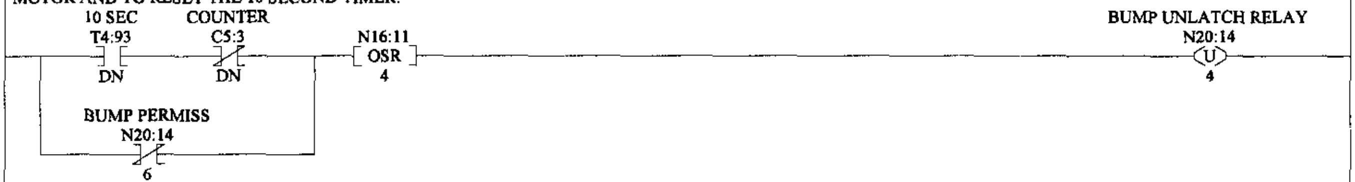
(END)

LAD 7 - --- Total Rungs in File = 36

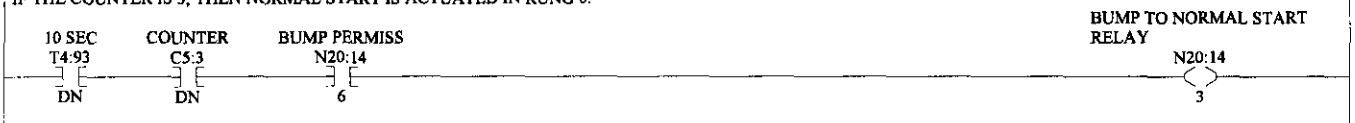


LAD 7 - --- Total Rungs in File = 36

IF THE COUNTER IS LESS THAN 3, THE BUMP START RELAY IS UNLATCHED TO ACTIVATE THE BUMP RELAY CONTACT IN RUNG 3 TO RESTART THE PUMP MOTOR AND TO RESET THE 10 SECOND TIMER.

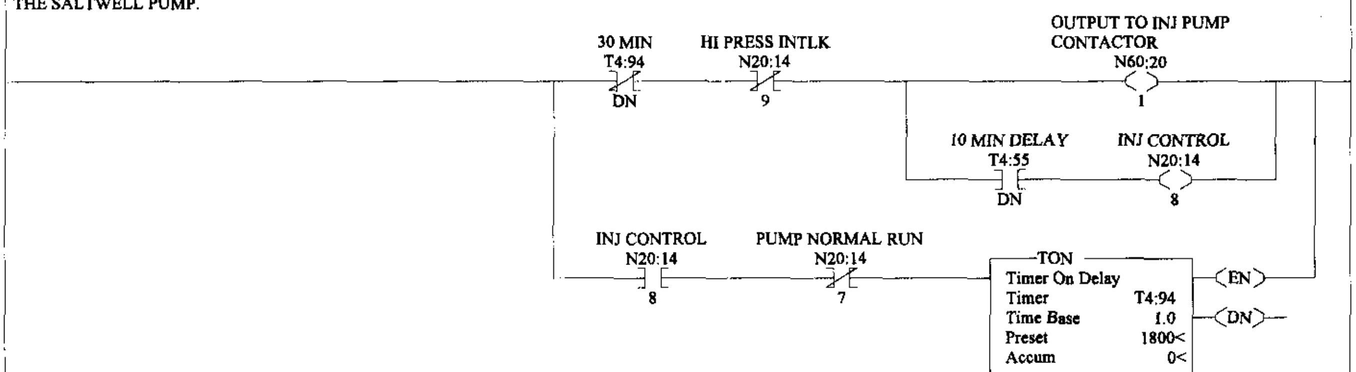
0009


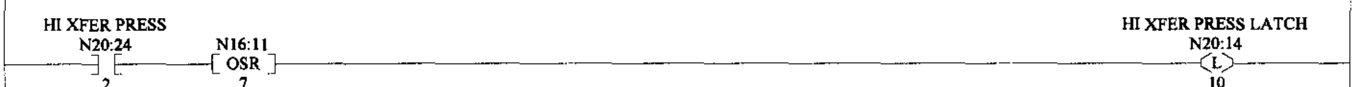
IF THE COUNTER IS 3, THEN NORMAL START IS ACTUATED IN RUNG 0.

0010


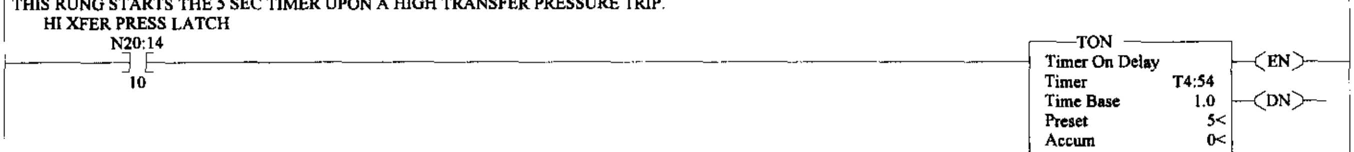
0011


THIS RUNG CONTROLS THE INJECTION PUMP SHUTDOWN. THE INJECTION PUMP WILL SHUT DOWN 30 MINS. AFTER THE SALTWELL PUMP SHUTS DOWN OR 40 MINS AFTER THE INJECTION PUMP STARTS AND THE SALTWELL PUMP HAS NOT STARTED OR WITHIN 5 SEC UPON A HIGH TRANSFER PRESSURE TRIP OF THE SALTWELL PUMP.

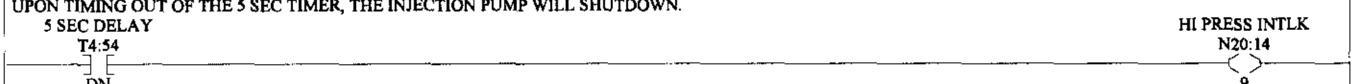
0012


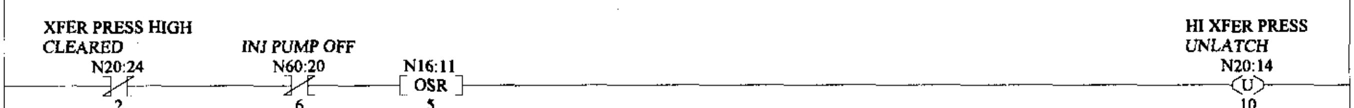
0013


THIS RUNG STARTS THE 5 SEC TIMER UPON A HIGH TRANSFER PRESSURE TRIP.

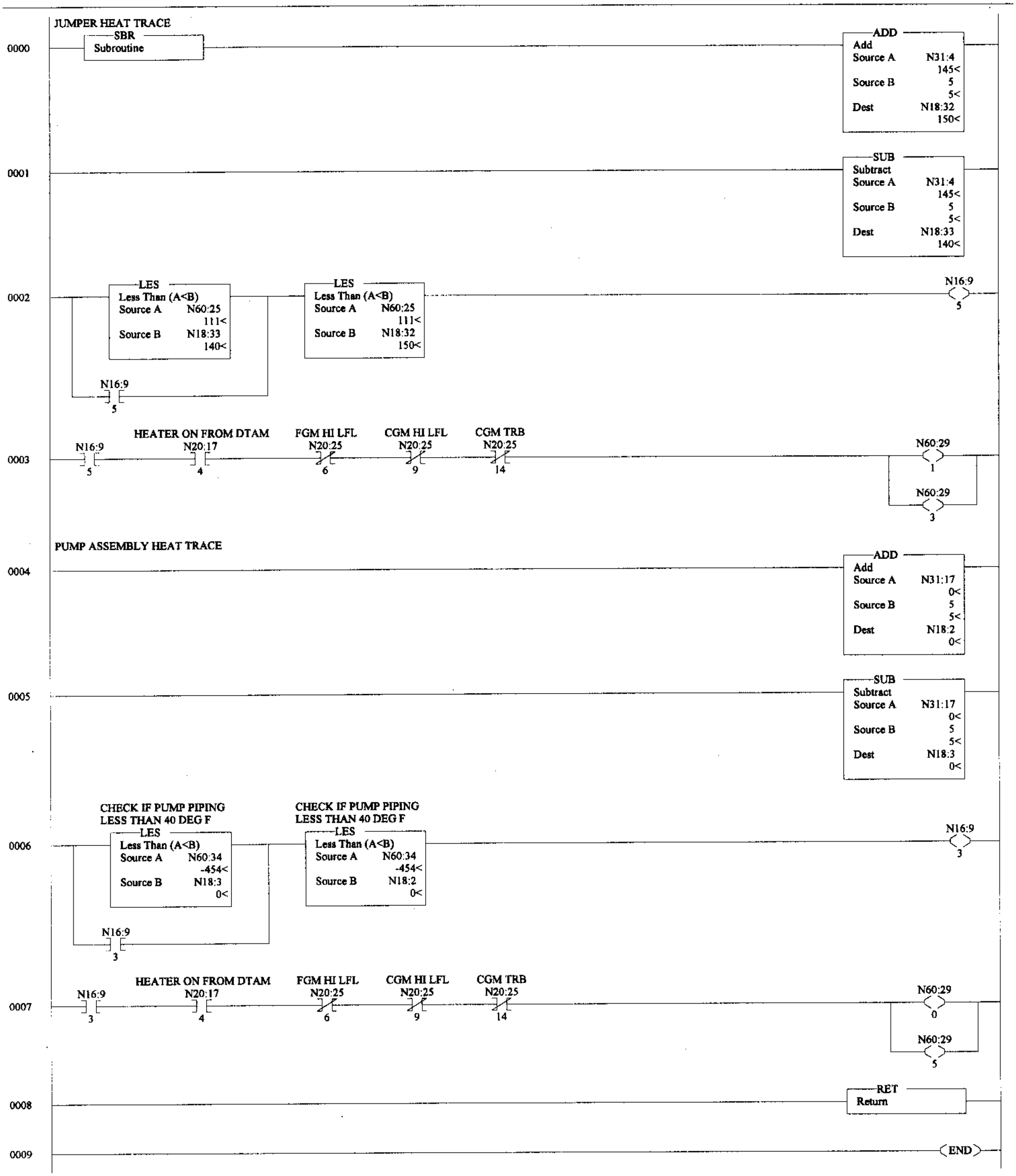
0014


UPON TIMING OUT OF THE 5 SEC TIMER, THE INJECTION PUMP WILL SHUTDOWN.

0015


0016


LAD 9 - --- Total Rungs in File = 10



LAD 19 - --- Total Rungs in File = 9

0000 SBR Subroutine — COP Copy File Source #N60:4 Dest #O:2.0 Length 2

MOVE OUTPUT TO MODULE 2 FOR DOV
SGT LOW
N20:24
13

0001 — MOV Move Source N13:0 0< Dest O:2.0 0<
— MOV Move Source N13:0 0< Dest N20:23 0<

MOVE OUTPUTS TO MODULE 6

0002 — MVM Masked Move Source N60:20 -1< Mask 003Fh 63< Dest O:6.0 0<

MOVE OUTPUTS TO MODULE 8

0003 — MVM Masked Move Source N60:28 3072< Mask 003Fh 63< Dest O:8.0 0<

MOVE OUTPUTS TO MODULE 9

0004 — MVM Masked Move Source N60:29 2762< Mask 003Fh 63< Dest O:9.0 10<

MOVE OUTPUTS TO MODULE 10

0005 — MVM Masked Move Source N60:30 256< Mask 003Fh 63< Dest O:10.0 0<

MOVE OUTPUTS TO MODULE 11

0006 — MVM Masked Move Source N60:31 34< Mask 003Fh 63< Dest O:11.0 34<

0007 — RET Return

0008 — (END)

LAD 20 - --- Total Rungs in File = 13

0000
SBR Subroutine

MOV Move
Source N60:15 3281<
Dest N30:0 3281<

0001
SCP Scale w/Parameters
Input N30:0 3281<
Input Min. 3277.0 3277.0<
Input Max. 16384.0 16384.0<
Scaled Min. 0.0 0.0<
Scaled Max. 14.0 14.0<
Output F8:20 0.0<

Calculate Total dilution ratio.

0002
MUL Multiply
Source A F8:20 0.0<
Source B N30:3 50<
Dest F8:21 0.0<

Calculate total dilution ratio.

0003
DIV Divide
Source A F8:21 0.0<
Source B 100.0 100.0<
Dest F8:21 0.0<

Metering pump flow range will not be less than Min Total dilution flow.

0004
LES Less Than (A<B)
Source A F8:21 0.0<
Source B F8:23 0.0<

MOV Move
Source F8:23 0.0<
Dest F8:21 0.0<

Metering pump flow range will not be greater than Max Total dilution flow.

0005
GRT Greater Than (A>B)
Source A F8:21 0.0<
Source B F8:24 0.0<

MOV Move
Source F8:24 0.0<
Dest F8:21 0.0<

Metering pump flow=Dilution flow - injection flow.

0006
SUB Subtract
Source A F8:21 0.0<
Source B F90:3 0.0<
Dest F8:22 0.0<

LAD 20 - --- Total Rungs in File = 13

If Metering pump flow is greater than 0.04 gpm then turn on metering pump.

0007 GEQ — Grtr Than or Eql (A>=B); Source A F8:22 0.0<; Source B 0.04 0.04< — DIL CONTACTOR N60:28 ( ) 1

Metering pump flow max is 4.0gpm.

0008 GEQ — Grtr Than or Eql (A>=B); Source A F8:22 0.0<; Source B 4.0 4.0< — MOV — Move; Source 4.0 4.0<; Dest F8:22 0.0<

Scaling output for metering pump flow.

0009 SCP — Scale w/Parameters; Input F8:22 0.0<; Input Min. 0.04 0.04<; Input Max. 4.0 4.0<; Scaled Min. 6242.0 6242.0<; Scaled Max. 31208.0 31208.0<; Output N30:2 18724<

0010 MOV — Move; Source N30:2 18724<; Dest N60:5 18724<

0011 RET — Return

0012 (END)

LAD 21 - - INJECTION FLOW TOTALIZER --- Total Rungs in File = 9